

Supply and Commercial Viability of Forage in Tanzania

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Abstract

This study aimed at understanding the forage potential and current dynamics in Tanzania so as to improve forage supply chains that would in turn increase availability, accessibility and affordability of forage to smallholder dairy farmers in North Eastern Tanzania. The study was a cross sectional in design and data were collected from review of literature and from 85 respondents using key informant interviews and focused group discussions. The data collected was summarized using Microsoft Excel and market system/sub sector analytical tools. Sub-sector mapping analysis was used to map the core forage actors, product flows and interrelationships. Results indicate that forage sub-sector growth is pinned down by several systemic constraints associated with availability, accessibility and affordability including climate change effects, relative small land availability for grazing and for forage producers, inadequate quality and certified forage seed supply, inadequate extension services, relative high capital investments and inadequate market development in support of whole forage market system. Furthermore, results indicate that forage market system in Tanzania is still at its infancy stage as forage commercialization practices is dominated by very limited large forage businesses. Main commercial forage farms in Tanzania produce essentially hay. Pwani and Tanga regions account for about 62% of the total hectares under forage production. The supporting functions by public and private sector are scattered and no clear policy and regulatory environment in place to promote the forage industry, yet the main driver in animal husbandry is proper feeding regime. In 2016/17, about 1,150,916 bales of hay were produced by both public and private farms. Price of forage varied per season and the variation depended mainly on the availability and cost of transportation. In conclusion, improvement is needed in the production, preservation and commercialization of forage in order to meet the growing demand.

Keywords: Forage; Market System; Availability; Commercialization.

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1. Introduction

Forage is a plant material mainly plant leaves and stems eaten by grazing livestock. It includes not only plants eaten by the animals directly such as pasture, crop residue, or immature cereal crops, but it is also including similar plants harvested as fodder and fed to the animals, in form of hay or silage. Across the world forages are the foundation of the livestock sub-sector. In Tanzania, livestock is a key agricultural sub-sector as the country that has the second largest livestock population on the African continent comprising 28.4 million cattle, 16.7 million goats and 5.0 million sheep [3,5]. Other livestock kept in the country include 1.9 million pigs, 72 million indigenous and commercial poultry, 0.6 million donkeys and 4.5 million ducks, guinea fowl, rabbits and other livestock species. Despite Tanzania accounting for 11% of the African cattle population, livestock-related activities contribute only 7.4% to Gross Domestic Product (GDP), 13% to the Agricultural Gross Domestic Product (Ag GDP) and growth of the livestock sub-sector at 2.6% is relatively low [3]. This growth largely reflects increase in livestock numbers, rather than productivity gains. Across the board, livestock productivity is low in Tanzania as it is in other developing economies. The low productivity of livestock in Tanzania is mainly due to poor nutrition caused by an inadequate quantity and poor quality of forage. Three main livestock production systems namely (i) traditional extensive production system which comprises agro-pastoralism and pastoralism, (ii) intensive or commercialized system, and (ii) semi-intensive production system, dominate livestock sub-sector in Tanzania [2]. The traditional extensive production system remains the dominant production system. It is estimated that over 96% of Tanzania's ruminant livestock population is kept under traditional extensive production system using communal grazing practices mostly in natural pastures. Only 4% of the country's ruminant livestock are raised under the semi-intensive and intensive commercial production systems. The semi-intensive system of ruminant livestock production is mostly in large-scale ranches and dairy farms while livestock under the intensive commercial system are kept in feedlots (for beef cattle) or under zero grazing for dairy cattle. The ruminant livestock producers meet their feed requirements through a combination of mainly grazing, crop residues (i.e. legume and cereal residues) and some planted forage. Others include collected feeds such as weeds, free leaves, banana pseudo stem and tubers or off-farm purchased feed such as concentrated feeds, supplements and cereal by product ingredients. Lately, the availability of and access to quality feed including forage remains an important constraint to intensification of livestock production in the above systems, as it is compounded by the effects of climate change. Seasonal variations in quantity and quality forage is common problem in Tanzania. In most cases animals are poorly fed, hence their production potentials are not realized. The availability and use of feeds to a large extent depends on rainfall, temperature and humidity variations which in turn vary with agro-ecological zones and the livestock production system. Forage availability is often abundant during the wet seasons whereas there are acute shortages of forage during the dry season with hardly sufficient feed to maintain animals. Seasonal forage availability results in seasonal milk availability and also in fluctuations of milk price that adversely affect incomes of particularly the smallholder farmers. It also results in seasonal movement or migration (temporary transhumance system) of animals to areas with pasture and water. During the periods of droughts when forage becomes scarce, rations deteriorate significantly, and production becomes low. Even though prices of forage may rise at such a period, it becomes difficult to make profits especially for smallholder's due to a combination of costs involved in buying forage and the low quality of forage available during such times. This leads to a high input – low output economic

situation for the smallholder dairy farmers. Viability for a smallholder dairy farmer is greatly affected mostly because the losses incurred during a period when forage becomes scarce may not fully be offset during the period of forage sufficiency where milk (selling) prices are likely to decrease. It is from this background this study was conducted aimed at understanding the forage potential and current dynamics in Tanzania so as to improve forage supply chains; production, preservation and commercialization in order to increase availability, accessibility and affordability of forage to smallholder dairy farmers.

The overall objective of the study was to assess the supply and commercial viability of forage in Tanzania. Explicitly, the study aimed to:

- Map forage market system/sub-sector in Tanzania.
- Map forage production (commercial volume) – location, acreages and type of forage in Tanzania.
- Explore the current production, preservation and commercialization practices of forage in Tanzania.
- Assess the systemic constraints associated with availability, accessibility and affordability of forage to smallholder dairy farmers in Tanzania.
- Recommend the necessary improvements and reforms needed to ensure better performance of a forage sub-sector.

2. Materials and Methods

This study adopted market system and value chain approach with a flow and sequence from input supply to consumption (as a subsystem in the dairy sub sector), to ensure that relevant information about forage market system is gathered and analyzed. As forage moves from the producer to the consumer, a number of transformations and transactions take place along the chain of interconnected activities, and value is added successively at each stage of the chain. But what is also key to consider is that these transactions are affected by the services market and the enabling environment in general. Understanding how the forage market system can become more competitive requires a systemic view of the markets, and the actors that comprise them. Improving competitiveness in a meaningful way requires a framework that examines the fabric of relationships between actors to identify and prioritize the opportunities and constraints and deal with underlying causes / effect of it. In order to achieve good internal consistency, logic and coherence of study report, the researcher used a combination of the following methods/tools:

- Review of published and unpublished literature, reports etc.
- Interview of key informants using a checklist of questions to be addressed
- Collection of secondary and primary data from authoritative or reliable sources such as government institutions [i.e. Tanzania Livestock Research Institute (TALIRI), Livestock Training Agency (LITA), Sokoine University of Agriculture (SUA), Ministry of Livestock and Fisheries (MLF)], individual commercial producers, service providers, as well as processors and traders of forage. Focus Group Discussions (FGDs) were employed when conducting inventory of forage demand with smallholder dairy farmers in the dairy cooperatives in the North-Eastern Tanzania.

Data were collected from 85 respondents using key informant interviews and focused group discussions. The data collected was summarized using Microsoft Excel and market system/sub sector analytical tools. Sub-sector mapping analysis was used to map the core forage actors, product flows and interrelationships.

2.1. Limitations of the study

The main challenge of this study is to get comprehensive and reliable data across the forage market system in the country. Consequently, the author had to apply great effort to make sense of the available data. In addition, the expansiveness in coverage of the forage activities all over the country is another challenge in terms of time allocated to carry out the study. Despite these limitations, through the methodology adopted, author strongly believes this paper has generated sufficient information.

3. Results

3.1. Forage market system/value chain assessment

The actors in the forage market system/value chain include Research and Development (R & D) organizations, input suppliers, producers, small forage vendors, traders, commercial ranches/dairy farms, dairy farmers and exporters of live ruminant animals. In this section of the report, researcher presents a Tanzania forage value chain map and describe the dynamics confronted by these actors, as they perform each of these value chain functions (Figure 1).

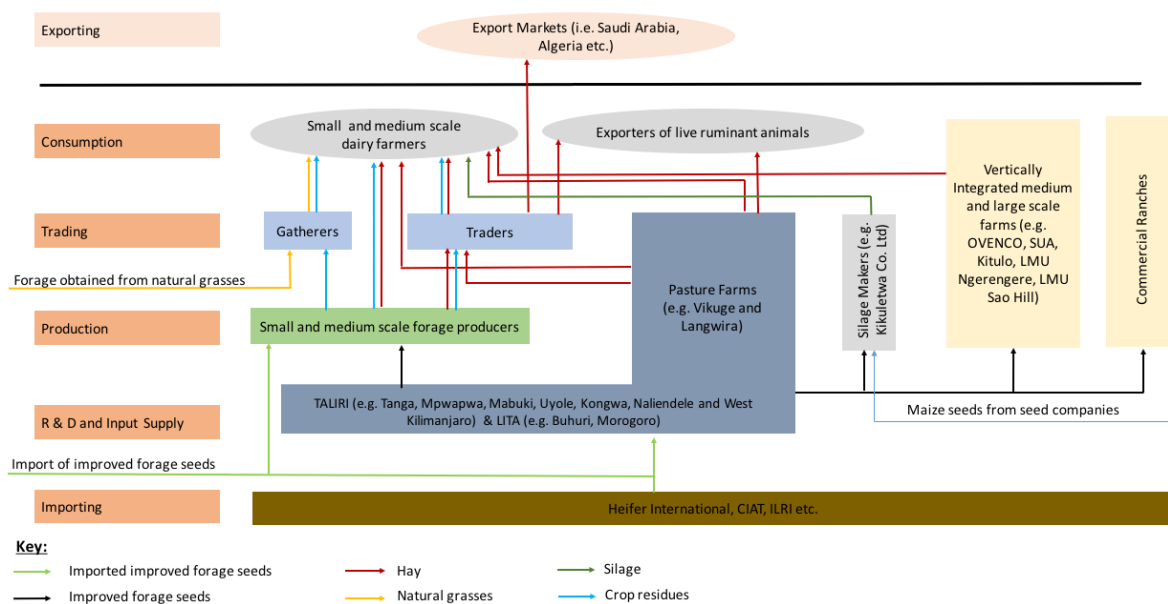


Figure 1: Tanzania forage value chain map

R & D and Input supply

Government of Tanzania is keen in research and development and has put in place TALIRI to enhance among others, forage productivity and production through research, technology development and dissemination. The

institute has seven research centers that are strategically located in seven agro-ecological zones of Tanzania Mainland. The centers are TALIRI Mwapwa and Kongwa (Dodoma), TALIRI Mabuki (Mwanza), TALIRI Naliendele (Mtwara), TALIRI Tanga, TALIRI Uyole (Mbeya) and TALIRI West Kilimanjaro (Kilimanjaro). Sokoine University of Agriculture and Tengeru Livestock Training Agency are among other institutions, which are also actively engaged in forage research. Forage production requires a wide range of the key inputs, including seeds, fertilizers, farm machinery/equipment and water. Extension services are relevant and necessary as well. Recently in Tanzania, forage seeds are supplied primarily by public institutions such as Vikuge Pasture Farms, Langwira Pasture Farm, TALIRI and LITA. International organizations like Heifer International, International Centre for Tropical Agriculture (CIAT) and International Livestock Research Institute (ILRI) import improved forage seeds mainly from Kenya for their projects and number of smallholder dairy farmers, who are beneficiaries of these projects have access to improved forage seeds and generally transplant during the relevant season. Farmers who do not have access to programs run by these international organizations hardly have a means to access improved forage seeds. Currently in Tanzania, use and adoption of improved forage seeds is still at infancy stage. Evidently, in 2016/17, only 3,717.1 and 731.5 kilograms of improved grasses and legumes seed respectively were produced by government pasture farms and sold to forage producers. Thus, there is inadequate production, multiplication and distribution of improved forage seeds. However, despite improvement which can be made by the use of improved seeds and fertilizers in forage production, very little fertilizers are used. Sometimes forage producers use their own made manure or buy manure from dairy farmers. Therefore, more effort is required to establish a sustainable forage seed map and input suppliers are required to ensure there is a reliable availability of these improved inputs at reasonable cost.

Production

Production of forage is mainly rain fed and is predominantly by large scale producers. However, there are few small-scale producers with less than five acres of land allocated to forage production. Large scale farms including public and private institutional farms (colleges, university, prison, military) and large company farms produce mainly natural grass mixture and Rhodes grass hay. In 2016/17, about 1,150,916 bales of hay were produced by public and private farms largely concentrated in Pwani and Tanga, which jointly contributed 64% of the total national hay production. The trend of private pasture farms' development in recent years across the country is promising (Figure 2).

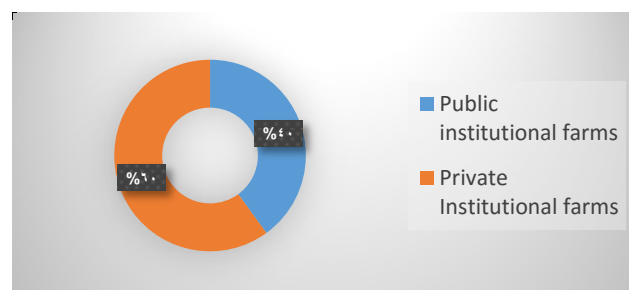


Figure 2: Production status of hay in Tanzania

During this study, it was noted that, most of forage producers were also dairy farmers, hence sold only what was in excess of their own requirements. The producers who did not have dairy cows were mainly crop farmers who sold crop residues after harvest and very few farmers who planted forage for sale. This indicate that the quantity of forage from individual farms that is found in the market is relatively low and this presents an opportunity for spreading forage production technologies. Also, during this study it was noted that, in the North-Eastern Tanzania, there is only one commercial producer and contractor of maize silage known as KIKULETWA FARM Ltd with capacity to produce 5 MT per day but still utilizing very small percentage of this capacity (i.e. less than 10%).

Trading

Across the country there are wide types of forage traded but the most common forage in the market is natural growing pastures, followed by crop residues. Other important forages were hay, established pastures and silage.

- **Naturally growing pastures:** Include a mixture of grasses, whose species varied widely. Though, these are abundant during rainy season and diminishes in the dry season. If they are to meet the needs of a growing livestock sub-sector, they must be maintained and utilized in a way that ensures the sustainable production of large quantities.
- **Crop residues:** include residues of maize, sorghum, rice, beans and millet. In addition, residues from wheat, barley, cassava, sweet potato vines, banana, groundnut, cowpea and processing residues from sugarcane tips, cotton, coffee pulps, sisal and cashew nut pulps are locally significant. However, crop residues were available during the harvest period of each specific crop.
- **Hay:** Natural grass mixture and Rhodes grass hay are the common forage types available in many places in the country throughout the year. However, the volumes traded varied across the country depending on the intensity of livestock production activities.
- **Established pastures:** include introduced pasture species, usually grasses in combination with legumes and trees forage. These types of forage are generally more productive than the natural growing pastures and have higher protein. Established grass species commonly found in Tanzania are Napier, Rhodes, Buffel, Guatemala, Setaria, Guines/Panicum maximum, Cenchrus ciliaris and Brachiaria ssp while common forage legumes include Lablab, Alfalfa, Desmodium ssp, Centrosema, Siratro, Stylo, Tropical kudzu, Clitoria ternatea, Calopo, Sunnhemp, Phasey bean and Glycine. However, forage legumes, which have higher feed quality than natural grasses, are scarce and poorly distributed throughout the year, and are in short supply in the dry season [2]. Other established pastures including forage trees such as Leucaena, Calliandra, Sesbania, Gliricidia, and Acacia.
- **Silage:** is very useful during dry season when there is a shortage for natural grazing. It is a preserved forage with high moisture content made from green crop. Napier and maize silage is now recognized and used in some regions in Tanzania especially Tanga, Morogoro, Arusha and Kilimanjaro. However, silage production strategy has never been widely adopted by majority of dairy farmers in Tanzania. Thus, making silage is very important for dairy farmers as silage can be fed to dairy cattle during times when forage is not good or natural forage is not available.

In the fresh forage market supply chain, forage trading business are dominated by small forage vendors who more often harvest free of charge forage from open unutilized public and/or private land such as in crop field, roadsides and in wetlands areas along the rivers and sell it to traders and/or consumers mainly smallholder dairy farmers located in urban and peri-urban areas. This may have implications on quality of forage traded. Dry forage predominantly from crops residues and hay market supply chain, traders dominate the business and most of them are not engaged in dairy farming. They carry out forage business trading purely as a business, signifying the importance of forage marketing as a source of income. Traders sell dry forage to dairy farmers, exporters of live ruminant animals, and export markets. They undertake bulking and aggregation of dry forage (i.e. hay) mostly directly from producers. Majority of these traders are based in urban and peri-urban areas of Dar es Salaam, Coast, Morogoro, Njombe, Tanga, Arusha and Kilimanjaro regions. They gather large quantities of dry forage from different producing areas and sell to dairy farmers. Some medium to large scale dairy farmers put orders with traders who bring the dry forage to their areas. However, most of live animal exporters (who need forage to feed their animals whilst on transit to the market) prefer to buy forage from public institutions and/or large private company farms at the farm gate prices hence gain economies of scale as well as quality assurance. The type of transport used to carry forage depends on the consumers', and traders' financial capability, quantity of forage and the distance. The common once being carrying on the head, bicycles, trucks, tractors, motor cycles and hand carts. Carrying on the head is done mostly by women while bicycles, trucks, tractors, motor cycles and hand carts are used mostly by men.

Consumption

Most consumers buy fresh forage daily, once or twice a week from producers, small forage vendors, and/or traders [1]. Dry forage such as hay and crop residues are usually purchased in large quantities and stored in sheds. During this study it was noted that, consumers mainly dairy farmers applied various strategies to enhance intake of the purchased forage. The common practice for fresh forage was chopping. But when feeding dry forage such as hay and crop residues, few dairy farmers chopped and sprinkled it with salted water, while few farmers use molasses. When feeding lactating animals, most of the consumers mix the forage with commercial concentrates or brewers' waste. Dairy farmers reported that they also feed maize bran and sunflower as well as cotton seedcake. The findings of this study reveal that there are increases in demand for forage in all urban and peri-urban areas in Tanzania and the markets demand in some rural areas are emerging due to scarcity of land and climate change. Major markets for forage in Tanzania are Dar es Salaam, Tanga, Pwani, Morogoro, Arusha, Kilimanjaro, Iringa, Njombe and Mbeya. However, demand for forage in these areas fluctuates significantly, however, due to differences in agro-ecological zones and accessibility of forage production technologies, it is possible to produce quality forage throughout the year in different parts of the country.

Exportation

Tanzania exports small volumes of forage in form of hay, mostly to Saudi Arabia, Comoro and to a lesser extent to Algeria in unstructured situations. Key informants interviewed during this study reported that, exports are seasonal and only happens when there is a high demand for forage in those export markets that cannot be met by their regular / prominent suppliers, as Tanzania is not a significant export country for forage.

3.2. Mapping of commercial forage production

The major resources for the forage value chain in Tanzania are people skills and knowledge, land, water, capital inputs and service delivery. The quality and quantity of these resources is key to the performance of the forage activities. Main commercial forage farms in Tanzania produce forage in form of hay and specifically two regions, namely Pwani and Tanga account for about 62% of the total hectares under forage production in Tanzania as visualized in Figure 3. Other regions with commercial forage production are Arusha, Morogoro, Dodoma, Mbeya, Iringa, Kagera, Mwanza, Manyara, Dar es Salaam, Kilimanjaro, Simiyu and Ruvuma.

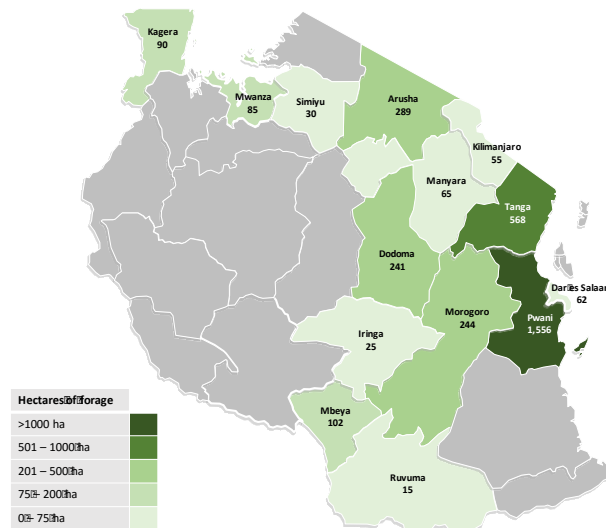


Figure 3: Hectares of commercial forage farms in Tanzania by regions

Pwani region is the largest forage producer, followed by Tanga, Arusha, Dodoma and Morogoro. Figure 4 presents the top five (5) forage producing regions in Tanzania.

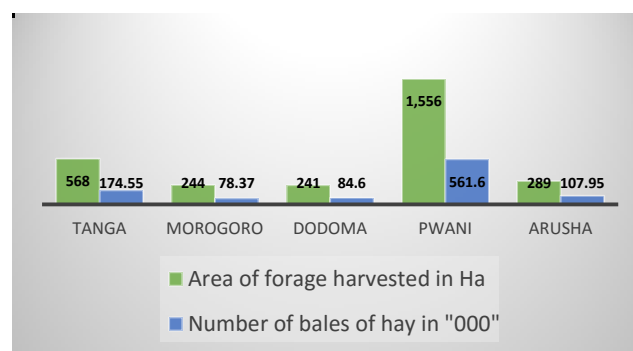


Figure 4: Top 5 forage producing regions in Tanzania

3.3. Forage preservation practices

Normally, majority of forage consumers particularly smallholder dairy farmers purchase fresh forage in small volumes and at short intervals. Dry forage such as crops residues are stored in barns or heaped under shade. This

clearly indicate that smallholder dairy farmers hardly practice any form of forage preservation in conventional manner. Forage traders also purchase forage in quantities enough to sell out because they do not practice any form of forage preservation. Currently, only medium and large-scale producers preserved forage in form of hay. Adoption of silage making practices by dairy farmers in Tanzania is still very low and among the factors attributed to the low adoption is lack of technical knowledge. There is a need to promote forage marketing alongside forage preservation practices as well as creating platforms for linkages among forage chain actors. Market information is needed to improve forage market systems. At the moment the most available information is about industrial feeds rather than about forages in the wider sense. This has created an information gap in a very important segment particularly of smallholder dairy production.

3.4. Forage commercialization practices

Forage commercialization practices is dominated by dairy farming business and in Tanzania, dairy farming is commonly practiced in the Southern Highlands, Northern Highlands and Kagera. However, it is gradually expanding to Tanga, Morogoro, Dar es Salaam and Pwani regions. In these areas, there is an emerging trend of the urban/peri – urban dairy farming that is mainly motivated by availability of milk market, need for creation of employment opportunities and ease of integration with other agro-economic activities. Majority of farm holdings in these areas are relatively small in size with 1 – 5 cows per households often under zero grazing [6]. However, one of the key constraints in these system of dairy production is inadequate supply of forage and poor nutritive quality of the available feed, resulting in low levels of productivity. While some farmers in these areas strive to produce their own forages, they often do not meet their demand due to a number of reasons, including limited land to grow forages, strong effects of seasonality of rainfall on available forage amongst others. Consequently, farmers are either pushed to purchase forages off farm, underfeed their cow with less forage, or feed excessive levels of concentrates, a strategy that is costly to most dairy farmers. Information from literature review indicates that there is very scanty information about forage markets and trading in Tanzania due to its informal nature. Though, forage markets and trading are particularly important for the landless and urban as well as peri-urban dairy farmers that have limited ability to produce enough forage, and need access to quality forage at reasonable prices to be able to produce more milk economically and at competitive cost. Evidence from this study has shown that there exists forage trading around peri-urban and urban areas in Tanzania especially in Dar es Salaam, Pwani, Tanga, Arusha, Kilimanjaro, Morogoro, Iringa, Njombe and Mbeya regions. In these areas forage generally moves from the source to the consumers through any available channel and in some cases directly from producer to consumer. The market actors purchase or gather forage from anywhere and sell to anyone willing to buy. During the rainy season when forage is in plenty, forage vendors mainly harvest free forage from open areas and may sell to traders or directly to consumers along the roadsides. During this time, some traders purchase forage mainly grass hay from large scale farms and institutions and sell to consumers. During the rainy season, some of the consumers do not purchase forage because it is available on farm and in open areas nearby and even some farmers who have excess may just give out free of charge. On the other hand, during dry season when there is scarcity of forage, dairy farmers/consumers run around everywhere looking for forage. They purchase forage from traders and even from producers. The small forage vendors at this time obtain most of their forage by purchasing from small-scale farms. Traders purchase forage from small and large-scale farms as well as from institutions even outside their district/region. This imply that little effort

has been made to improve forage markets. The cost of forage varied mainly between the dry and wet season mainly due to (i) availability, (ii) demand, and (iii) cost of transportation. Purchases of forage are generally done on cash basis. However, during times of scarcity some consumers make prior reservations with traders whom they have developed a working relationship. Traders also selectively make reservations with some producers. In some occasions, the consumers could obtain forage on short term credit basis. During the rainy season, traders are sometimes forced to offer the forage on credit instead of leaving it to rot. There are also instances where consumers gave manure to crop farmers in exchange for forage or/and crop residues. It has been observed that hay commercialization is quite low in the Northern Tanzania, and this presents an opportunity to start up commercialization of forage. The landed price of hay in the Northern Tanzania with a 15% profit margin is averagely US \$ 0.18 per kg. But Dairy farmers currently pay an average of US \$ 0.36 per kg of maize stover and the demand is fairly stable across households. It is therefore evident that if hay is promoted it shall easily substitute maize stover which is of much inferior quality.

3.5. Systemic constraints associated with availability, accessibility and affordability of forage

1. Climate change has significantly affected the availability of forage. Extended dry season, frequent drought, erratic rainfall expressed by shifts in onset and cessation of rain and increased temperatures have drastically cause seasonal variation in forage availability.
2. Another main cause of shortage of forage is relatively small land available for grazing and for forage producers taking into consideration the high population of ruminant animals in the country. Land available for grazing [4] in Tanzania is only 10% (Figure 5).

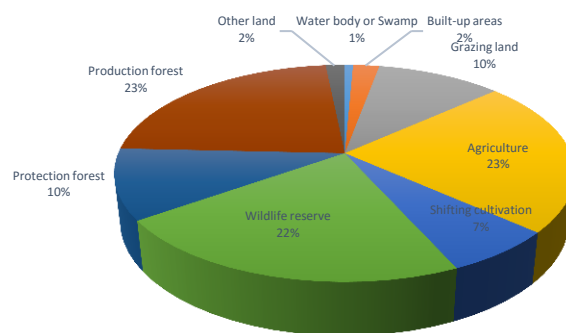


Figure 5: Land use distribution in Tanzania mainland

3. Inadequate quality and certified forage seed supply has also been a serious obstacle to forage development in Tanzania. Where such seeds have been difficult to obtain due to high cost. Also, the use of even manure leaves alone fertilizer to improve the productivity of unimproved local forage species has been nearly impossible owing to high labor intensity and costs.
4. Inadequate extension services - there have been too few sufficiently competent extension workers to advice farmers on forage production. Good forage production tends to suffer from weed invasion, improper cutting and frequency height, poor agronomic practices including pests and diseases control resulting from inadequate extension services and hence reduction in forage yield especially during the

dry season.

5. Relatively high capital investments such as farm machinery/equipment for forage production, which includes establishment, management, harvesting and preservation.
6. Inadequate market development (demand & supply sides) support of forage market system in Tanzania, which has left it underdeveloped.

3.6. Enabling environment – forage sub-sector

In Tanzania, there is *Grazing-Land and Animal Feed Resources Act of 2010*. An Act to provide for the management and control of grazing-lands, animal feed resources and trade and to provide for other related matters. However, on the ground, there were no regulations and/or institutional structures, guiding forage production and trading business that was not recognized by local or national governments. There is no licensing and regulatory body for developing relevant guidelines for forage quality and enforcing its compliance. Also, there is no deliberate efforts for creating relevant advocacy and lobbying platforms for forage issues.

4. Conclusions and recommendations

Forage production is very important component of Tanzania's livestock sub-sector development, from the perspective of providing adequate and quality feed for the livestock. Unfortunately, the forage market system is still at its infancy stage. Improvement is needed in the production and preservation of forage in order to meet the increasing demand. These demands can hardly be met without developing or adopting technologies that will enhance the yield and quality of the various forage species existing in the country, and promotion of commercialization models.

- Farmers should be encouraged/incentivized to use of improved quality and/or certified pasture forage species which have proven to be more drought tolerant as well establishment of forage banks.
- Forage producers should be encourage/incentivized by government to use of irrigation facilities, wherever available, in the establishment and production of forage in order to increase feed resources for livestock.
- Government and NGOs should introduce and encourage forage preservation in the form of hay and silage among livestock producers in order to extend feed suppliers for improving animal performance.
- Consider the possibility of land reallocation to avail more land for grazing. To do so there is a need for government ministries, including the Ministry of Land Housing and Urban Development; Ministry of Agriculture, Ministry of Livestock and Fisheries, Ministry of Natural Resources and Tourism, the Prime Minister's Office and Regional Administration and Local Government, which are the main stakeholders of land in the country, to conduct dialogue on proper use of land to explore possibilities of using forages available in the production forests and shifting cultivation areas.
- Establish a sustainable forage seed map in Tanzania and input suppliers as well as improve Tanzania laboratory testing facilities for pasture seed testing.
- Encourage dairy farmers to considered alkali treatment and supplementation when feeding crop residues in order to reduce wastage.

- Provide civil education on the value of pasture as a crop for dairy farmers.
- There should be deliberate efforts of research and regulatory institutions in promoting the use of quality and certified seeds which will be affordable to farmers.

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